JACOBS UNIVERSITY

International Logistics and Management Engineering

Graduate Program

Contents

1 Introduction to the Graduate Program

1.1 Concept

The graduate program ”International Logistics: Management and Engineering” (ILME) addresses:

- students with a bachelor degree in science and/or in engineering and/or management who are fascinated by the challenges and opportunities of the modern logistics industry as the backbone of global trade, production and distribution.
- students with a Master degree in science and/or engineering and/or management seeking a PhD degree in a interdisciplinary, applied field with excellent global academic and/or professional career possibilities.
- professionals with a suitable degree, who are interested in both, gaining expertise in logistics research on the cutting edge, and improving their professional skills in order to master the next step in their professional carrier.

The program aims at educating and training leaders of tomorrow to deal with complex problems using engineering and management skills.

Whereas the bachelor program in International Logistics Management and Engineering at Jacobs University mainly focuses on introducing *logistics processes*, the graduate program in addition concentrates on describing, analyzing and designing *logistics systems* and their interplay.

Current logistics systems face highly dynamic environmental conditions in a globalized and heavily networked world. The pre-condition of efficiently running global logistics systems is robustness. Thus, the program especially addresses the design and the management of robust logistics systems. A logistics system can be a highly aggregated production network, a warehouse, a production plant or a transportation system, or a combination and inter-connection of all of them. The design of material flow, for instance, a factory layout, the planning or dimensioning of a warehouse or the conception of a distribution system will be among the subjects of this graduate study program *International Logistics: Management and Engineering*. Aligning the systems' structures and the required functions, value creation by the layout of the logistics processes are addressed The approaches, the barriers, and the facilitators of the change management in a logistics system are treated. The importance and the concepts of leadership that reflect the technological and intellectual capital within a global logistics network are emphasized.

The overarching aim is to provide the students with tools and insights about how the performance and robustness of global logistics systems can be achieved and sustainingly maintained.

The successfully graduating students shall be qualified to cope with the complex challenges of analyzing, designing and leading global value networks. They will acquire knowledge in the appropriate terminology, theoretical concepts and analytical frameworks. Understanding approaches for improving efficiency and robustness of large logistics systems, and the capability of sustainable problem solving via rational and responsible managerial decision making will contribute to the targeted competence profile. Gaining an integrative perspective of the analysis, design and control of complex adaptive but nevertheless robust logistics systems is a central issue. Training of socio-cultural competencies completes the education.

A unique feature of this graduate study program is the outstanding combination of the engineering perspective, information and communication technologies (ICT), and the management perspective on an equal footing. Engineering aspects will be combined with ICT and intertwined with management skills in order to provide the students with a sustainable and holistic portfolio of competencies. This refers to the fact that evidently a product must be developed and produced before it can be sold and eventually delivered.

Another outstanding feature refers to the carefully balanced integration of learning, researching and applying. The study program comprises several components, which provide knowledge by guided learning in lectures, literature reviews and case studies. Additionally, it includes training of the student's capabilities of exploration, examination and explanation by autonomously working on research projects. The results of the project work will be presented in seminars, and eventually in the master thesis. Finally, the program will provide the students with a practical understanding of logistics systems during guided industrial projects. The program will allow the students to acquire deep insights into the real world of logistics via guest lectures, a guided industrial project, and empirical research.

The third unique feature of this study program is its blended learning approach. Different forms and types of learning "technologies" are combined. *Lectures* provide the students with basic knowledge and create motivation. *Case studies* deepen the understanding and know how independently and according to individual needs and interests. *Seminars* lead students towards working on subjects on their own using literature, and train presentation skills. Project workshops train students to solve tasks in teams, and prepare for working eventually on the project of the master thesis.

1.2 Degrees

The program offers three degrees, namely the "Master of Science" (MSc), the Executive Master (MSc) and the "Doctor of Philosophy" (PhD).

1.2.1 The Master of Science (MSc)

The students who enter the ILME graduate program with a Bachelor degree may choose to obtain a Master of Science (MSc) after successfully completing the Master thesis in the 4^{th} semester. Obtaining the degree Master of Science regularly takes two years of study equivalent to 4 semesters. The first three semesters consist of regular course work, mainly during the first two semesters, and scientific project work, starting after the second semester. During semester breaks practical experience is collected in companies.

Provided a sufficiently high performance in the first three semesters is achieved and a qualifying examination is successfully passed, students are permitted to complete their Master thesis during the 4^{th} semester. Upon graduation, the "Master of Science in International Logistics: Management and Engineering" is awarded.

1.2.2 The Executive Master (MME)

Students with a professional background entering the graduate program can aim at an Executive Master(MSc).

The program consists of courses and projects, including the Master Thesis, *with a total workload that is equivalent* to two study years. The course work during the first study year is equivalent to the one of the MSc program. As a rule, students are requested to study on campus during this period.

During the 3^{rd} semester students perform project work. They may stay in their home company and meet each other, and their supervisors, only during certain workshops and seminars on campus during this period.

After a qualifying examination, they start working on their master project. Latest during the 4^{th} semester, they complete their master thesis which can be completed off-campus while staying in their companies.

1.2.3 The Doctor of Philosophy (PhD)

Students with an excellent record of achievement in their Bachelor's or Master's studies may apply to directly pursue an Integrated PhD degree (holders of a BSc) or a PhD degree (holders of a MSc) at Jacobs University.

Students joining the Integrated PhD track are required to complete successfully three semesters of courses and project work and a qualifying examination similar as in the MSc program before progressing to the PhD research phase.

Students with a Master's degree who have demonstrated an aptitude to research may progress immediately to the PhD research phase, upon recommendation of the faculty and subject to approval by the Dean. In order to obtain a PhD degree up to three years of working on a research project is required. Upon graduation, Jacobs University Bremen awards the PhD in "International Logistics Management and Engineering".

As a rule, Jacobs University awards a PhD degree. Alternatively, Doctors of Philosophy may carry the German "Dr." in front of their name.

1.3 Career Perspectives

The program prepares students - on the Master of Science, Executive Master and the PhD level - either for an executive carrier in the logistics industry or a scientific career at a university or a research institute. It is the major aim to enable students to successfully transfer their scientific profound knowledge to a professional life in an economical environment. Concerning the scientific perspective the program offers training in a wide range of aspects of logistics areas.

Students will be prepared for different management functions, such as in Marketing and Personnel Departments, Category Management and Management of Shipping Department. They will be qualified for a wide range of positions in engineering such as Process Management, Corporate Sourcing or Production Planning.

The program focuses not only on providing essential knowledge and skills in the areas of Logistics Management and Engineering. It provides also possibilities for each student to individually shape his/her personality. Apart from functional skills, students are well trained in methodological skills, such as Presentation, Language and Controlling. Training of social and communication skills completes the graduate education. Flexibility and working in an international team are further important ingredients. In order to provide insights from logistics practice the curriculum includes lectures with business executives as lecturers. The graduate logistics students get in close contact with leading professionals from industry.

The Career Service (http://www.jacobs-university.de/services/career/) offers assistance by supporting with advice and tools for pursuing rewarding careers after graduation. Jacobs University's Alumni Association establishes a worldwide network of graduates representing additional expertise. This opens additional job options (http://www.jacobs-university.de/about/alumni/).

As Jacobs University hosts students from more than 90 nations graduate students experience an international community, which fosters considerably intercultural training.

In conclusion, studying at Jacobs University offers unique opportunities to develop, shape, and optimize the individual profiles. By integrating theoretical lectures with practical expertise, professional career counseling, the international alumni network, and being embedded in Jacobs' international Campus community, a comprehensive education including training of soft skills is achieved, and a thorough preparation of students for their future careers is guaranteed.

1.4 Target Audience and Requirements

For detailed information please refer to the Jacobs University Graduate Policies under www.jacobs-university.de/policies. In case of conflict with the procedural rules described in this handbook the Jacobs University Graduate Policies always take precedence.

1.4.1 Master of Science (MSc)

The Master of Science program addresses:

- students with BA/BSc degrees in Logistics, Engineering and/or Management,
- students with BA/BSc degrees in other disciplines if a strong interest in logistics can be identified and if the former degree has provided the candidate with sufficient core competencies,
- graduate students with MSc/MA in a field related to the program,
- young professionals with an academic degree that is equivalent to a BA/BSc and/or MA/MSc in a suitable field related to the program.

Candidates for the Master of Science in International Logistics should fulfill the following requirements:

- practical experience - at least one year - (recommended),
- a strong record of academic and/or professional achievements,
- sufficient command of English language and basic skills in German,
- profound knowledge of formal methods.

1.4.2 Executive Master (MME)

The Executive Master program addresses professionals from companies:

- who want to prepare for the next step in their carriers
- who have at least a Bachelor degree in Engineering and/or Management
- or who have a Bachelor or Master degree in another related discipline.

1.4.3 Doctor of Philosophy (PhD)

Students with a Jacobs University recognized MSc/MA or equivalent degree for example a German Diploma, in a field relevant for the field of Logistics can directly enter the PhD program. They conduct independent research in the group of one of the participating faculty. Upon successful completion of their research projects students receive a PhD degree in the field of the supervisor.

2 Study Program

The graduate program consists of a **Qualification Phase** and an **Advanced Research Phase**.

The **Qualification Phase** consists of three steps. They are equivalent to the first three semesters of the program, namely

- **Methods and Tools**,
- **Complex Systems**,
- **Guided Projects**.

The step "**Methods and Tools**" provides the students with advanced tools that are necessary for describing, analyzing and designing logistics systems. The step "**Complex Systems**" provides knowledge in specific logistics topics. In "**Guided Projects**" the students shall be enabled to successfully work on their own projects, a necessary competence for developing new solutions. The students deepen their practical experience during this step.

The step **Advanced Research Phase** differs between the Master degrees (duration one semester) and the PhD degree (duration six semesters). In all tracks of the graduate program this phase contains a self-contained research project.

2.1 Structure of the Qualification Phase

For successfully completing of the qualification phase for the MSc and the integrated PhD tracks a total of 90 ECTS credits have to be earned by participating in

- methods courses (20 credits),
- specialization courses (40 credits),
- actively in graduate seminars (15 credits),
- in guided projects or completing a guided industrial project (15 credits).

In the case of the PhD track, the guided project work may result in the PhD proposal which has to be defended latest after eight month after starting the **Advanced Research Phase**.

The integrated teaching concept of *blended learning* is used during the **Qualification Phase**. It combines different learning methods as lectures and case studies, literature reviews, labs, excursions, guest lectures and e-learning.

The types of learning methods and the detailed topics may vary from year to year. The idea is to assemble individual combinations of learning forms around a given topic in order to import the knowledge relevant for a given topic and to satisfy the learning necessities of the students at the same time.

At least 20 ECTS credits must be earned in every semester of the **Qualification Phase** with an average grade of 3.0 or better, otherwise the student will be placed on academic probation. A graduate student with a GPA in any given semester worse than 4.33 will be automatically suspended.

2.1.1 Methods and Tools - 1^{st} Semester

The step *Methods and Tools* (1^{st} semester, 30 credit points) is divided into four blocks: "Formal Methods", "Engineering", "Management" and "Leadership Skills". All blocks are mandatory.

Within a block students can select modules individually. The block "Formal Methods" counts 10 credit points. The the blocks "Engineering" and "Management" count 7.5 credit points each. Usually two modules for each block will be offered, from which students have to choose one.

The block "Formal Methods" provides students with generic knowledge that is vital but not original for logistics namely *Advanced Mathematics and Algorithms and Statistical Modeling Methods*. They are not only used in logistics, but in many other management functions as in Marketing and Finance. *Advanced Mathematics* provides students with the necessary skills in higher mathematics for modeling and simulation of logistics systems. *Algorithms and Statistical Modeling* provides the tools for formally analyzing complex logistics systems.

The block "Engineering" provides students with methods that are originally used in and developed for logistics issues. This block contains the modules *Autonomous Systems in Logistics* and *Advanced Modeling and Simulation of Logistics Systems*. *Autonomous Systems in Logistics* introduces the idea of self-cooperating and self-controlling systems. *Advanced Modeling and Simulation of Logistics Systems* focuses on instruments for sophisticated representation of logistics systems in complex models and simulations in order to provide the logistics management with tools for planning, optimizing and controlling. This module introduces and discusses a comprehensive spectrum of current approaches in modeling and outlines future developments.

The block "Management" provides students with management tools for planning, controlling and analyzing logistics systems. The focus of this block lies on measuring and creating performance and structures as well as processes for complex supply networks. The block offers the modules *Controlling of Supply Chains* and *Organizational Designs for Supply Networks*. The module *Controlling of Supply Chains* includes instruments for value-based management and advanced controlling and it provides the students with an introduction to SAP as a worldwide-used enterprize resource planning software. The module *Organizational Design for Supply Networks* provides an introduction to network theories and an overview about organizational theories. The focus is on managing and shaping complex logistics networks.

The block "Leadership Skills" focuses in this step only on intercultural competencies and communication. It includes an intense language training in German (or in a different language for German native speakers).

2.1.2 Complex Systems - 2^{nd} Semester

The step *Complex Systems* (2^{nd} semester, 30 credit points) includes the four blocks: "Leadership Skills", "Distribution Logistics", "Maritime Logistics" and "Production Logistics".

The block "Leadership Skills" is mandatory for all students. It counts 10 credit points. It comprises two mandatory modules, *Management competencies* (7.5 credit points) and *Intercultural competencies* (2.5 credit points). The former includes courses that train the management competencies of the students for future leading positions in industries and science. Therefore, the module focuses on training in project management, decision making as well as team and group leading. The latter addresses inter-cultural competencies. It offers courses in intercultural communication and additional language courses in German or another language for German native speakers.

From the blocks "Distribution Logistics", "Maritime Logistics" and "Production Logistics" the students have to select 2 out of 3 blocks (20 credit points). Within a given block a student can

select modules individually. Usually two modules will be offered for each block.

The block "Distributions Logistics" includes modules that cope with challenges and solutions of multi-modal transportation systems and of sustainable logistics. In the module *Systems for Transportation and Warehousing* the focus lies on modeling, planning and controlling complex transportation tasks. Additionally, systems for warehouse management will be addressed. The module *Sustainable Logistics* includes issues like Green Logistics and Logistics for Renewable Energy Supply.

The block "Maritime Logistics" provides an understanding of maritime transport, the most environmental-friendly transportation, also covering hinterland transport by other transport modes. The main objective is to provide a profound knowledge of business processes and innovations in maritime transport technologies to increase productivity, reliability, sustainability and working conditions. Improving business processes requires new innovative solutions based on the potential of information and communication technologies. Students will be enabled to analyze systems and develop methods and tools for improving processes under economic and technical aspects and in relation to the carbon footprint of operations.

The block "Productions Logistics" contains the module **Advanced Studies in Supply Chain Design**" and the module *Smart Parts in Logistics. Advanced Studies in Supply Chain Design* analyzes the design of infrastructure, processes and system's features as well as functions from an engineering perspective. For example options for designing a production side or a warehouse will be examined. *Smart Parts in Logistics* focuses on so-called intelligent technologies (e.g. RFID) and their applicability to logistics tasks as well as advanced engineering related topics in logistics such as logistics-oriented design of technologies or information technologies in logistics.

2.1.3 Guided Projects - 3^{rd} Semester

The step *Guided Projects* (3^{rd} semester, 30 credit points) encloses the three blocks "Seminar on Engineering", "Seminar on Management" and the "Guided Industrial Project". All blocks are mandatory.

The block "Seminar on Engineering" focuses on a given research topic which is combined with data from industry. This ensures knowledge of current research topics and to develop an understanding of existing logistics problems.

The block "Seminar on Management" will be held in cooperation with a logistics service provider or a company from a different industry which faces interesting logistics problems. Both seminars aim at analyzing a practical problem of a company and providing a feasible and intelligent solution, which has to be developed by the students. The problem analysis as well as the development of a solution will be embedded in the theoretically profound framework and intend to apply scientific research results to practical issues. For both seminars the students have to work on such a problem in teams under the supervision of lecturers and company's representatives. The students will work out presentations, scientific papers and reports about their work. A kick-off meeting, several workshops as well as a final presentation and discussion in front of the company's management can be components of this seminar.

The block "Guided Industrial Project" (GIP) confronts the students with practical logistics problems of companies. Thereby, students experience practical situations beyond their theo-

retical studies. Moreover, they work on these problems in dedicated teams. They learn how to split up tasks, how to work together, and how to behave and communicate in a professional context in order to take on the necessary steps.

2.2 The MSc Phase

In the Master of Science Program, *Advanced Research* (4^{th} semester, 30 credit points), the students combine all of their acquired competencies, skills and capabilities in writing their Master Thesis in order to deepen and show their qualification in advanced project work.

The master thesis in logistics represents an important document of the competencies acquired during the study program. Hence it is a highly relevant argument in the later job application process of the student. The topic of study as well as the approach shall be related to a real logistics problem of a company and shall show the capability of a student to analyze and solve a complex logistics problem. Besides that, it is an opportunity to demonstrate scientific skills and the gained knowledge as well as the ability to develop new insights. The thesis displays the comprehensive understanding of the underlying field. It makes an original contribution to logistics theory and/or practice. Additionally, in the development process the student proofs his skills in analyzing and solving a single problem based on a target-oriented application of scientific instruments and a critical reflection of current relevant scientific literature. Thereby, the student has to comply with necessary quality standards as well as with requirements for scientific research outlined in the corresponding guidelines.

In order to receive the MSc degree, a total of 120 ECTS credits are needed. The Master Thesis must be finished by the end of the (4^{th} semester and is awarded with 30 credits. Credits are awarded only if the grade is better than 4.0. If the thesis does not fulfill this requirement, the examination committee may agree that the thesis is resubmitted within three months.

2.3 The Executive MSc Phase

The final step of the Executive Master Program is identical to the final step of the MSc program. The only difference is that the students can write the Master Thesis in their home company.

2.4 The PhD Phase

The three-year PhD phase is devoted to active research within the research group of an academic supervisor, or multiple advisors whenever possible, in order to foster interdisciplinary research within ILME.

This phase can be entered either by a student with a Bachelor degree after having successfully completed the Qualification Phase or by a student with a Master degree. In both cases, it is required that the student has found at least one ILME faculty member who is willing to supervise the PhD project.

Students who enter the final PhD phase from the Qualification Phase typically choose their supervisor after the 2nd semester, before starting to work on their PhD research proposal.

Students who enter with a Master degree by a direct application choose the supervisor during the application/acceptance process. Figure 3 shows an overview of the final PhD phase.

BSc	MSc		
Semester	**Semester**	**Title**	**Activity**
1-3	-	Qualification Phase for Integrated PhD	
4	1	PhD Definition	Development Thesis Proposal, Public Defense of Proposal at the End of the Semester
5	2	PhD Research	
6	3	PhD Research	
7	4	PhD Research	Evaluation and Refinement Phase, Written Progress Assessment by the Thesis Committee at the End of the Semester
8	5	PhD Research	Thesis Preparation, Publications
9	6	PhD Research	Completion of PhD Thesis, Public Defense

Figure 3: The structure of the final PhD phase. Numbering of semesters depends on whether the student entered with a BSc or an MSc.

Integrated PhD students who have successfully completed the Qualification Phase and found a supervisor, start to work on their PhD proposal during the 4^{th} semester. During the first semester of the final phase, the student works out a thesis proposal in collaboration with his academic supervisor(s). The proposal must

- demonstrate that the student masters the professional terminology in the research domain and has the requisite background knowledge,
- identify and motivate a relevant, novel, and feasible research question,
- connect the question to the state of the art by an illustrative literature overview,
- design experiments, theoretical investigations/implementations, including a time line,
- describe the criteria for evaluating the eventual success of the project.

At the end of the 1^{st} semester of the final phase, a doctoral thesis committee is constituted and the proposal is defended in a publicly.

After (and if) the thesis proposal is successfully defended, in the remaining time the proposed research is carried out. It is only natural that the originally stated objectives are refined or even re-defined in this process. Progress is monitored by presentations within group-seminars, which are mandatory for the PhD students, and on a day-by-day basis in close interaction with the supervisor.

The final semester is devoted to writing up the thesis document. At the end of the program, the findings are presented to the graduate program and the university in a public PhD thesis defense. The thesis committee judges the presentation in the thesis defense together with the content and form of the thesis to determine whether to accept or reject the thesis. The PhD thesis is usually not graded within the Jacobs University grading system but may be awarded with the predicate ”with distinction”.

PhD students are encouraged but not required to participate in courses to broaden and deepen

their knowledge in the different related fields.

Teaching experience is part of graduate education. All graduate students are encouraged to work in undergraduate courses as teaching assistants (TAs). This includes among other activities giving tutorials, grading exercise sheets, and supervising lab or undergraduate project work. According to their experience, PhD students may also work out exercise sheets or define undergraduate projects and offer seminars.

3 Courses

The following table shows an exemplary study plan. The courses actually offered might change due to changing students' requests, available capacities and a quorum of five students per course. The updated course plan with the valid course descriptions will be provided via the website of the study program.

Year	Semester	Step	Block	Modules	Courses	Form	CP
1	1	**Methods & Tools (30 CP)** (All Blocks are mandatory; the students have to choose one module out of two from each block)	Formal Methods (10 CP out of 20 CP)	Advanced Mathematics (10 CP)	ESM3A	L	5
					ESM4A	L	5
				Algorithmical and Statistical Modelling (10 CP)	Algorithmical and Statistical Modelling	L	5
					Algorithmical and Statistical Modelling Lab	LAB	5
			Engineering Methods (7,5 CP out of 15 CP)	Autonomous Systems in Logistics (7,5 CP)	Autonomous Systems	L	5
					Autonomy in Logistics Systems	LR	2.5
				Advanced Modelling & Simulation of Logistics Systems (7,5)	Advanced Modelling & Simulation	L	2.5
					Advanced Modelling & Simulation Lab	LAB	2.5
					Critique on Modelling & Simulation Methods	LR	2.5
			Management Methods (7,5 CP out of 15 CP)	Controlling of Supply Chains (7,5 CP)	Advanced Studies in Controlling for Logistics	L	2.5
					Value Based Management	LR	2.5
					SAP Lab	LAB	2.5
				Organizational Design for Supply Networks (7,5 CP)	Introduction to Organizational Theories for Networks	L	2.5
					Organizational Theories	LR	2.5
					Managing Complex Networks	CS	2.5
			Leadership Skills (5 CP)	Intercultural Competencies (5 CP)	German (or other language courses for German native speakers)	LAB	5
	2	**Complex Systems** (Leadership Skills is mandatory with 10 CP; the students have to choose two other blocks out of the three elective ones; within one block chosen the students have to decide for one module out of two)	Production Logistics (10 CP out of 20 CP)	Advanced Studies in Supply Chain Design (10 CP)	Supply Chain Design	L	2.5
					Designing a Production Site	LAB	2.5
					Intelligent Designs of Logistics Systems	LR	2.5
					Developing a Sophisticated Design for a Complex System	CS	2.5
				Smart Systems in Logistics (10 CP)	Smart Systems	L	2.5
					Programming an Intelligent Production System	LAB	2.5
					Smart Technologies in Production Logistics	LR	2.5
					The Future of Artificial Intelligence	LR	2.5
			Distribution Logistics (10 CP out of 20 CP)	Systems for Transportation and Warehousing (10 CP)	Introduction to Multimodal Logistics	L	2.5
					Modelling Complex Transportation Systems	LAB	2.5
					Introduction to Advanced Warehouse Management	L	2.5
					Managing a Warehouse	LAB	2.5
				Sustainable Logistics (10 CP)	"Greener the Logistics" - Ecological Challenges for Logistics Service Providers	L	2.5
					Environmental Issues in Supply Chains	LR	2.5
					Logistic Processes for Renewable Energy Infrastructure and Distribution	L	2.5
					Offshore Windparks and their Requirements for Logistics	CS	2.5
			Maritime Logistics (10 CP out of 20 CP)	Maritime Transport Systems (10 CP)	Maritime Transport Management	BL	5
					Maritime Transport Systems Technology	BL	5
				Port and Terminal Management (10 CP)	Terminal Management	BL	5
					Port Management	BL	5
			Leadership Skills (10 CP)	Management Competencies (7,5 CP)	Project Management	LAB	2.5
					Decision Making	LAB	2.5
					Leading Teams and Groups	LAB	2.5
				Intercultural Competencies (5 CP)	German (or other language courses for German native speakers)	LAB	2.5
2	3	**Guided Projects**	Seminar Engineering (7,5 CP)			S	7.5
			Seminar Management (7,5 CP)			S	7.5
			Guided Industrial Project (15 CP)			GIP	15
	4	**Advanced Research**	Master Thesis (30 CP)			MT	30

L = Lecture; LAB = Laboratory; CS = Case Study; S = Seminar; LR = Literature Review; GIP = Guided Industrial Project; MT = Master Thesis; BL = Blended Learning (e-learning, face-to-face session, case study, excursion)